WHAT IS CLAIMED IS:

1. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power source, in which a cutting pulse is output for time T1 to the high-frequency power source to stop a supply of power to the glow-discharge apparatus, when dVr/dt - dVf/dt increases over a first level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; and arc discharge is determined to have developed in the glow-discharge apparatus, when Vr/Vf increases to a second level or a higher level within a preset time To after the supply of power to the glow-discharge apparatus is stopped.

2. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power source, in which a cutting pulse is output for time T1 to the high-frequency power source to stop a supply of power to the glow-discharge apparatus, when dVr/dt - dVf/dt increases over a first level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; arc discharge is determined to have developed in the glow-discharge apparatus, when Vr/Vf increases to a second level or a higher level within a preset time To after the supply of power to the glow-discharge apparatus is stopped; and the supply

of power to the glow-discharge apparatus is further stopped for time T1 after the arc discharge is detected.

3. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power source, in which a cutting pulse is output for time T1 to the high-frequency power source to stop a supply of power to the glow-discharge apparatus, when dVr/dt - dVf/dt increases over a first level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; and arc discharge is determined to have developed in the glow-discharge apparatus, when Vr/Vf increases to a second level or a higher level and Vf becomes greater than Vfmax $\times$ 0.05 within a preset time To after the supply of power to the glow-discharge apparatus is stopped.

4. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power source, in which a cutting pulse is output for time T1 to the high-frequency power source to stop a supply of power to the glow-discharge apparatus, when dVr/dt - dVf/dt increases over a first level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; arc discharge is determined to have developed in the glow-discharge apparatus, when Vr/Vf

increases to a second level or a higher level and Vf becomes greater than Vfmax × 0.05 within a preset time To after the supply of power to the glow-discharge apparatus is stopped; and the supply of power to the glow-discharge apparatus is further stopped for time T1 after the arc discharge is detected.

5. The method of detecting arc discharge, according to any one of claims 1 to 4, wherein the first level ranges from Vfmax*0.05 to Vfmax*0.2, the second level ranges from 0.5 to 0.95.

6. The method of detecting arc discharge, according to any one of claims 1 to 4, wherein the arc discharge is determined to have developed when Vr/Vf remains at the second level or a higher level for time T2 or longer.

7. The method of detecting arc discharge, according to claim 6, wherein the first level ranges from Vfmax*0.05 to Vfmax*0.2, and the second level ranges from 0.5 to 0.95.

8. The method of detecting arc discharge, according to claims 1 to 4, wherein the preset time To is measured, starting at a trailing edge of the cutting pulse.

9. The method of detecting arc discharge, according to claim 6, wherein the preset time To is measured, starting at a trailing edge of the cutting pulse.

10. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power source, in which a load to the glow-discharge apparatus is determined to undergo impedance matching, when Vr/Vf is at a third level or a lower level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; and arc discharge is determined to have developed in the glow-discharge apparatus, when Vr/Vf thereafter increases to a second level or a higher level.

11. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power source, in which a load to the glow-discharge apparatus is determined to undergo impedance matching, when Vr/Vf is at a third level or a lower level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; arc discharge is determined to have developed in the glow-discharge apparatus, when Vr/Vf thereafter increases to a second level or a higher level; and a supply of power to the high-frequency power source is stopped for time T1 after the arc discharge is detected.

12. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power source, in which a load to the glow-discharge

apparatus is determined to undergo impedance matching, when Vr/Vf is at a third level or a lower level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; and arc discharge is determined to have developed in the glow-discharge apparatus, when Vr/Vf thereafter increases to a second level or a higher level and Vf is greater than Vfmax × 0.05.

13. A method of detecting arc discharge in a glow-discharge apparatus that has a high-frequency power source, in which a load to the glow-discharge apparatus is determined to undergo impedance matching, when Vr/Vf is at a third level or a lower level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied to the glow-discharge apparatus, respectively; arc discharge is determined to have developed in the glow-discharge apparatus, when Vr/Vf thereafter increases to a second level or a higher level and Vf is greater than Vfmax × 0.05; and a supply of power to the high-frequency power source is stopped for time T1 after the arc discharge is detected.

14. The method of detecting arc discharge, according to any one of claims 10 to 13, wherein the second level ranges from 0.5 to 0.95, and the third level ranges from 0.05 to 0.5.

15. A high-frequency arc-discharge control apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a first cutting-pulse output unit which outputs a cutting pulse for time T1 to the high-frequency power source when dVr/dt - dVf/dt increases over a first level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a second cutting-pulse output unit which outputs the cutting pulse again for time T1 to the high-frequency power source when Vr/Vf increases over a second level within a preset time To after the first cutting-pulse output unit outputs a cutting pulse.

16. A high-frequency arc-discharge control apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a first cutting-pulse output unit which outputs a cutting pulse for time T1 to the high-frequency power source when dVr/dt - dVf/dt increases over a first level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a second cutting-pulse output unit which outputs the cutting pulse again for time T1 to the high-frequency power source when Vr/Vf increases over a second level within a preset time To after the first cutting-pulse output unit outputs a cutting-pulse, and outputs the cutting pulse again for time T1 to the high-frequency power source when Vr/Vf increases over a second level within a preset time To after outputting the cutting pulse to the high-frequency power source.

17. A high-frequency arc-discharge control apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a first cutting-pulse output unit which outputs a cutting pulse for time T1 to the high-frequency power source when dVr/dt - dVf/dt increases over a first level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a second cutting-pulse output unit which outputs the cutting pulse again for time T1 to the high-frequency power source when Vr/Vf increases over a second level and Vf becomes greater than Vfmax $\times$ 0.05 within a preset time To after the first cutting-pulse output unit outputs a cutting pulse.

18. A high-frequency arc-discharge control

apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a first cutting-pulse output unit which outputs a cutting pulse for time T1 to the high-frequency power source when dVr/dt - dVf/dt increases over a first level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a second cutting-pulse output unit which outputs the cutting pulse again for time T1 to the high-frequency power source when Vr/Vf increases over a second level and Vf becomes greater than Vfmax × 0.05 within a preset time To after the first cutting-pulse output unit outputs a cutting-pulse, and outputs the cutting pulse again for time T1 to the high-frequency power source when Vr/Vf increases over a second level and Vf becomes greater than Vfmax × 0.05 within a preset time To after outputting the cutting pulse to the high-frequency power source.

19. The high-frequency arc-discharge control apparatus according to any one of claims 15 to 18, wherein the first level ranges from Vfmax*0.05 to Vfmax*0.2, the second level ranges from 0.5 to 0.95.

20. The high-frequency arc-discharge control apparatus according to any one of claims 15 to 18,

wherein the second cutting-pulse output unit determines that the arc discharge has developed, when Vr/Vf remains at the second level or a higher level for time T2 or longer.

21. The high-frequency arc-discharge control apparatus according to claim 20, wherein the first level ranges from Vfmax*0.05 to Vfmax*0.2, and the second level ranges from 0.5 to 0.95.

22. The high-frequency arc-discharge control apparatus according to claims 15 to 18, wherein the preset time To is measured, starting at a trailing edge of the cutting pulse.

23. The high-frequency arc-discharge control apparatus according to claim 20, wherein the preset time To is measured, starting at a trailing edge of the cutting pulse.

24. A high-frequency arc-discharge control apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a matching-storing unit which stores data representing that a load undergoes impedance matching, when Vr/Vf is at a third level or a lower level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a cutting-pulse output unit which outputs a cutting pulse to the high-frequency power source when Vr/Vf increases to a second level or a higher level while the matching-storing unit is storing the data representing that the load undergoes impedance matching.

25. A high-frequency arc-discharge control apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a matching-storing unit which stores data representing that a load undergoes impedance matching, when Vr/Vf is at a third level or a lower level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a cutting-pulse output unit which outputs a cutting pulse to the high-frequency power source when Vr/Vf increases to a second level or a higher level while the matching-storing unit is storing the data representing that the load undergoes impedance matching, and outputs the cutting-pulse again for time T1 to the high-frequency power source when Vr/Vf increases to the second level or a higher level within a preset time To after the cutting pulse is output to the high-frequency power source.

26. A high-frequency arc-discharge control apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a matching-storing unit which stores data representing that a load undergoes impedance matching, when Vr/Vf is at a third level or a lower level, where Vf and Vr are a traveling-wave voltage and a reflected-wave voltage applied from the power meter, respectively; and

a cutting-pulse output unit which outputs a cutting pulse to the high-frequency power source when Vr/Vf increases to a second level or a higher level and Vf becomes greater than Vfmax $\times$ 0.05 while the matching-storing unit is storing the data representing that the load undergoes impedance matching.

27. A high-frequency arc-discharge control apparatus comprising:

a glow-discharge apparatus which receives power from a high-frequency power source through a power meter and an impedance-matching circuit;

a matching-storing unit which stores data representing that a load undergoes impedance matching, when Vr/Vf is at a third level or a lower level, where Vf and Vr are a traveling-wave voltage and

a reflected-wave voltage applied from the power meter, respectively; and

a cutting-pulse output unit which outputs a cutting pulse to the high-frequency power source when Vr/Vf increases to a second level or a higher level and Vf becomes greater than Vfmax × 0.05 while the matching-storing unit is storing the data representing that the load undergoes impedance matching, and outputs the cutting-pulse again for time T1 to the high-frequency power source when Vr/Vf increases to the second level or a higher level within a preset time To after the cutting pulse is output to the high-frequency power source.

28. The high-frequency arc-discharge control apparatus according to any one of claims 24 to 27, wherein the second level ranges from 0.5 to 0.95, and the third level ranges from 0.05 to 0.5.